PWR SIMULATOR COURSE
WESTINGHOUSE DESIGN
R-624P OUTLINE

Day	Title	Sim/ CR	Time (hr.)
1			
	Course Introduction	CR	1
	Initial Panel Familiarization	Sim	1
	Review Of Rod Control And Excore Nuclear Instruments	Sim	1
	Review Of General Operating Procedure For Plant Startup	Sim	1
	Review Of Permissive And Interlock Panels	Sim	1
	Reactor Startups	Sim	1
	Review Of Condensate & Feedwater Systems and Steam Generator Level Control	Sim	1
2			
	Review Of CVCS, Pressurizer Level Control, And EHC	Sim	1
	Reactor Startups (Cont.)	Sim	2
	Plant Operations	Sim	1
	Review Of Main Steam System And Steam Dumps	Sim	1
	Plant Operations	Sim	1
	Discuss organization, symbols, and use of P&IDs	Sim	1
3			
	Review Of RCS, Pressurizer Pressure Control, And Primary Temperature	Sim	.5
	Plant Operations	Sim	1
	Present EOP Structure and Control Room Usage	CR	1
	Present E-0	CR	1
		Sim	1
	Plant Operations	Sim	1
	Review Of SW, CCW, And Containment Ventilation Systems	Sim	.5
	Plant Operations	Sim	1
4			
	Present Emergency Plan	CR	1
	Plant Operations (Review P&IDs, Logics & FSAR)	CR	1
	RCS Leak Requiring A Plant Shutdown	Sim	2
	Review Of Electrical Systems	Sim	1
	Present E-1 & E-2 (Review EP usage during exercise)	CR	1
		Sim	1
5			
	Present E-3	CR	1
	Steam Generator Tube Leak	Sim	2.5
	Plant Operations/Control Board Review	Sim	1
	Static Examination (25%)	Sim	2.5

6	Present FR-S.1 Power Operations Present FR-FR-C.1, & FR-P.1 Power Operations (Instrument failures requiring use of P&IDs, ONIs & logics)	CR Sim CR Sim	1 2.5 1 2.5
7	Present ECA-0.0 Reactor Trip/SI Scenarios	CR Sim	1.5 5.5
8	Present FR-H.1 Emergency Operations	CR Sim	1.5 5.5
9	Emergency/Off Normal Scenarios	Sim	7.0
10	Final Static Examination (75%)	Sim	2.5

Lesson # 624P-1.1 Title: Course Introduction	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with information concerning the following:

- 1.1.1 Course related information
- 1.1.2 Simulator use information
- 1.1.3 Initial control room familiarization

2.0 References and Additional Materials

- 2.1 Student Information Sheets
- 2.2 Simulator Handout book

R-624P
Simulator
Class

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.1 Title: Course Introduction

3.0 Presentation:

A. Work Hours
   1. The course end time is 3:00 pm on Friday. There will be an allowance of 1 hour for the static examination with an optional review of 0.5 hour after the static. The static will start at about 1:30 pm.

B. Lunch
   1. One hour
   2. Restaurants, brown bag, etc.

C. Conduct while in the simulator, DO NOT:
   1. Put feet or drinks on the panels
   2. Write on the panels, meter faces or procedure manuals
   3. Use the instructor's console or remote operator
   4. Manipulate switches during instructor demonstrations
   5. Smoke in the building

D. Emergencies
   1. Explain and show the following:
      a. Computer emergency shutdown
      b. Emergency exits
      c. Location of fire extinguishers
      d. Assembly area
      e. 911- Review TTC area location

E. Course Organization
   1. System reviews at local panels
   2. Operations
      a. Startups, power operations, shutdowns, and accidents.
      b. Technical Specification reviews incorporated with daily operations.
      c. Use provided procedures.
      d. Final exam consists of two static evaluations of the plant. Exams will be on each Friday afternoon. The first exam weights 25% and the final exam weights 75%.

e. Incorporate student scenarios as applicable. If not feasible at the time requested, time is allocated at the end of the day or at the end of the course.

F. Course Documentation
1. Have students fill out the student information sheet.

G. Initial Control Panel Familiarization
1. Walk through the simulator showing the general layout of the panels.
   a. Panel designators
   b. Point out major system locations
2. Point out location of the following:
   a. Procedures
   b. Technical Specifications
   c. System diagrams and prints

H. Panel Status Evaluation
1. Describe how to evaluate plant status with information supplied by the various indications available in the control room.
   a. Annunciators
      1) acknowledging
      2) resetting
      3) testing
   b. Status Panels
      1) RPS bistable status
      2) ESF status
   c. Valve and breaker indications
      1) Red lamps
      2) Green lamps
      3) White lamps
      4) Amber lamps
      5) Both red and green lit
      6) Power on bus
      7) Breaker charged
   d. Controllers
      1) Automatic control
      2) Manual control
      3) Response to power failure

Lesson # 624P-1.2	Title: System Review - Rod Control & Excore Instrumentation	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Rod Control System and the Excore Nuclear Instrumentation System:

1.1.1 Controls that be manipulated by the student during the course of a reactor startup, shutdown, and /or power operation.

1.1.2 Control switches that must be operated to block reactor trip signals or to inhibit/bypass faulted instruments from various automatic control stations.

1.1.3 Indications available to the student from this location used to evaluate the status of the core.

2.0 References and Additional Materials

2.1 RCS Temperature Instrumentation (page 23)

2.2 Rod Control System (pages 17, 18, 19, & 20)

2.3 Source and Intermediate Range Nuclear Instruments Block Diagrams (page 21)

2.4 Power Range Nuclear Instrument Block Diagram (page 22)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.2 Title: Course Introduction

	3.0 Presentation: A. Controls (Show use and location of the following) 1. Rod bank auto/manual selector 2. IN-HOLD-OUT switch 3. Source range block/reset 4. Intermediate range block 5. Power range block 6. Startup reset 7. Rod control alarm reset 8. Tavg and ΔT defeat switches 9. Both manual trip switches B. Instrumentation (Show use and location of the following) 1. Source range count and SUR 2. Intermediate range current and SUR 3. Power range level and Δ flux 4. Step counters 5. RCS temperature a. OPΔT b. OTΔT c. ΔT d. Tavg 6. NR-45 recorder 7. Tref/Tavg auctioneered
K-12 B-4 K-12 E-1 & F-1 K-12 C-4 K-12 C-1 K-12 D-1	C. Annunciation to be aware of during startup 1. SR HI FLUX AT S/D BLOC 2. ROD BOTTOM ANNUNCIATION 3. SR HI VOLT FAIL 4. ROD BANK LIMIT LO 5. ROD BANK LIMIT LO-LO
{TS 3.1.5} **{TS 3.1.8}** **{SR 3.1.5.3}** **{TS 3.1.6}** **{TS 3.1.7}** **{TS 3.2.3}** **{TS 3.2.4}** **{TS 3.3.1}**	D. Associated Technical Specifications 1. Control Rods a. Control rod operability b. Rod position indication c. Rod drop times d. Rod insertion limits 2. Excore Nuclear Instruments a. Axial Flux Difference b. Quadrant Power Tilt Ratio c. Reactor Protection System

Lesson # 624P-1.3 Title: System Review - Bistable Status Panel	Time: 60 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with information concerning the following:

- 1.1.1 Use of procedures
- 1.1.2 Layout of the General Operating Instructions (GOIs)
- 1.1.3 Precautions and limitations to follow during startup
- 1.1.4 License limits
- 1.1.5 Information available from the protection system permissive status panel and the bypass status panel.

2.0 References and Additional Materials

- 2.1 GOI 2-2
- 2.2 PLS
- 2.3 Technical Specifications
- 2.4 Logic Drawings [M1T-13 (1 thru 16)]

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.3 Title: System Review - Bistable Status Panels
INIT 8 (NOTE: IC 7 is unstable)	**3.0 Presentation:** A. General Operating Instruction Format 1. Purpose 2. Precautions and Limitations 3. Initial Conditions 4. Procedure
GOI 2-1 is complete until MFP is desired.	B. Precautions and Limitations (GOI 2-2)
This procedure has 25 precautions. These precautions should be discussed in some detail before a Rx S/U.	1. Section 4.1
{TR-Table 5.1.2-1} **{TS 3.1.5}** **{TS 3.1.6}** **{TS 3.1.7}** **{TS 3.1.8}**	a. Operating personnel b. Criticality limitations c. Ensures a controlled approach to critical conditions d. Ensures shutdown capability with the control rods e. Ensures rod position systems are aligned prior to rod motion f. Ensures shutdown capability with the control rods g. Shutdown rods must be fully withdrawn prior to control rod motion per **{SR 3.1.6.1}**. h. SUR within the limitations as per PLS i. Ensures controlled approach to criticality
{TS 2.1.1} **{TS 3.4.2}** **{TS 3.4.1}**	C. License Limit Requirements 1. Limits addressed by checklists at the end of the procedure. 2. Briefly discuss the following items in Checklist 3: a. Safety Limits b. Minimum temperature for criticality c. DNB Parameters
Introduce the use of control room logic drawings [M1T-13 (1 thru 16)]	D. Protection System Bistable Status Panel 1. Explain how all protective bistables (permissives, reactor trips, and ESF actuations) are shown on panel 2. Briefly describe the logic behind lights coming on and going off for the permissives

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.3 Title: System Review - Bistable Status Panels

	E. Control Interlock Bistable Status Panel 1. Explain how the control interlocks are displayed on panel 2. Briefly describe the steam dump arming lights for steam dumps

Lesson # 624P-1.4 Title: Reactor Startups	Time: 4 Hours
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide simulator orientation to the student

1.2 Provide the student with the following:

- 1.2.1 An understanding of how the core is made critical.
- 1.2.2 How to recognize criticality.
- 1.2.3 How to control the reactivity of the core.
- 1.2.4 Effects of subcritical multiplication.
- 1.2.5 Technical specifications that may be entered during rod withdrawal.

2.0 References and Additional Materials

2.1 General Operating Instruction 2-2

2.2 Technical Specifications

2.3 Control Room Operating Curves and Table Reference Manual

2.4 Panel Familiarization (EI-0 Checklist)

2.5 AFW Equipment Lineup (Optional)

2.6 ECCS Equipment Lineup (Optional)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.4 Title: Reactor Startups

INIT 8	**3.0 Presentation:** NOTE: It take approximately 30 minutes to perform each startup and escalate power to $5E^{-10}$ amps.
	A. Each student should take the reactor critical and escalate power to at least $5E^{-10}$ amps.
OI 8-1	1. If the class is small (3 or 4) power may be reaised to POAH. In any case, the last 2 or 3 startups should be raising power to at least 2% and starting a main feedwater pump.
	B. Have students not directly involved with the startup complete the checklists as referenced on the cover sheet.
	C. Perform reactor startup IAW GOI 2-2
	D. Provide students with ECC
PLP RCS 1 PZR 2 CVC 3	1. 120 steps on bank D for first startup 2. For subsequent startups, vary the boric acid concentration in the RCS to vary the critical rod position. A change of ±1 ppm will change critical rod position by approximately 2 steps.
	E. Explain how to recognize criticality
	1. Describe how the count rate at criticality can be changed by allowing subcritical multiplication to increase counts. a. Recall that theoretically the core can be taken to 100% power without achieving criticality. However, in practice, this cannot be accomplished due to rod worth.
	F. Ensure the students are aware of the following Technical Specification items:
{TS 3.4.2} **{TS 3.1.7}**	1. Minimum temperature for criticality. 2. Rod insertion limits

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.4 Title: Reactor Startups
CROC&TRM Figure 1.20	G. Startup Demonstration 1. Initial Conditions a. Have students take the reactor critical and level power at $5E^{-10}$ amps. b. Pull rods to achieve ½ dpm SUR c. Ask students to determine final power 1) Monitor power on indications 2) Note point of doppler and MTC feedback 3) Calculate reactivity added by rod motion for final SUR 4) Use power defect curve to determine final power

Lesson # 624P-1.5	Title: System Review - Condensate, Feedwater, Auxiliary Feedwater, & Steam Generator Water Level Control	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the condensate, feedwater, auxiliary feedwater, and steam generator level control systems:

1.1.1 Controls that be manipulated by the student during the course of a reactor startup, shutdown, and /or power operation.

1.1.2 Controllers that must be manipulated during power operations.

1.1.3 Indications available to the student from this location used to evaluate the status of the secondary plant.

2.0 References and Additional Materials

2.1 Technical Specifications

2.2 Condensate System (page 15)

2.3 Feedwater System (page 16)

2.4 Auxiliary Feedwater System (page 9)

2.5 Steam Generator Feedwater Control System (page 27)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.5 Title: Condensate, Feedwater, Auxiliary Feedwater, & Steam Generator Water Level Control

INIT 16	**3.0 Presentation:** A. System Description 1. Use diagram to show flowpath of the water from the sources to the S/G B. Controls (Show the location and operation of the following:) 1. Aux feed pump S/G level control valves 2. MFW bypass control valves 3. MFW control valves 4. Reactor trip switches (both) 5. Feed pump controls a. Point out general location, a more detailed description will be provided during feed pump startup. 6. Feed isolation valves and B/P valves indications, and FWIS Reset 7. Block switches for steam line flow SI C. Instrumentation 1. Location and use of the following: a. S/G level indicators b. S/G pressure indicators c. Condensate storage tank level d. Aux feed flow to S/G e. AFW pumps indications (pressure, flow, amps, steam chest pressure, etc.) 2. Show the location of the S/G feed, steam, and level recorders D. Technical Specifications 1. Feedwater System a. Feedwater isolation valves 2. Auxiliary Feedwater a. AFW pumps b. Condensate storage tank c. AFW instrumentation 1) Remote shutdown panels 2) Accident monitoring
{TS 3.7.6}	
{TS 3.7.3} {TS 3.6.3}	
{TS 3.7.5} {TS 3.7.6	
{TS 3.3.4} {TS 3.3.3}	

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-1.5 Title: Condensate, Feedwater, Auxiliary Feedwater, & Steam Generator Water Level Control

{TS 3.3.1} {TS 3.3.4} {TS 3.3.3} {TS 3.3.2}	3. Steam Generator Level Control a. Steam generator level 1) RPS 2) Remote Shutdown 3) Accident monitoring 4) ESF related signals
{TS 3.3.2} {TS 3.3.4} {TS 3.3.3}	b. Steam Generator pressure 1) ESFAS 2) Remote shutdown 3) Accident monitoring

Lesson # 624P-2.1	Title: System Review - CVCS, PZR Level , & EHC	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the CVCS, PZR Level , & EHC.

1.1.1 Controls that may be manipulated by the student during the course of a reactor startup and/or power operations.

1.1.2 Control switches that must be operated to block faulted instruments from various automatic control stations.

1.1.3 Indications available to the student from this location used to evaluate the status of the RCS (CVCS and PZR level) or the main turbine/generator (EHC).

2.0 References and Additional Materials

2.1 Chemical & Volume Control System (page 3)

2.2 Pressurizer Level Control System (page 26)

2.3 Reactor Makeup System (page 4)

2.4 EHC Speed Control and Load Control (Refer to Sim. Handout, Appendix B)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.1 Title: System Review - CVCS, PZR Level , & EHC

INIT 16 **{TR 3.1.1 thru 3.1.9}** **{TR 3.4.1}** **{TS 3.4.16}**	**3.0 Presentation:** A. CVCS 1. Review the CVCS with the diagram a. Show major component locations on the control panel b. Show the major instrumentation associated with CVCS 2. Explain uses of back pressure regulator (PK-131) 3. Explain function of temperature divert valve (HIS-129) 4. Explain the interlocks associated with the letdown isolation valves (HIS-459 and 460) and the letdown orifice isolation valves (HIS-8149A, 8149B, & 8149C) a. Cannot close 459 or 460 unless orifice valves are closed b. Cannot open 459 or 460 unless orifice valves are closed c. Cannot open 8149A, B or C unless letdown isolation valves are open d. Cannot open either set of valves if pzr level < 17% 5. T.S. associated with CVCS a. Boric acid and dilution flow paths b. Centrifugal charging pumps c. RCS specific activity and RCS Chemistry (indirect T.S. due to flow through demineralizers) B. CVCS Makeup 1. Review makeup system with diagram 2. Explain auto mode setup on MCB a. Boric acid controller setpoint b. Pure water controller internal setpoint 3. Explain how to set up controllers for borations and dilutions a. Reset b. Open windows and set in desired amounts c. Start

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.1 Title: System Review - CVCS, PZR Level , & EHC
{TS 3.3.1} {TS 3.3.4} {TS 3.3.3}	C. Pressurizer Level Control 1. Inputs into system a. Auctioneered high Tavg b. Selected pressurizer level 2. Components controlled by system a. Annunciators b. Turn on backup heaters c. CCP discharge flow control valve (FCV-121) d. PDP pump speed e. Letdown isolation valves f. Orifice isolation valves g. 17% level heater interlock 3. Control boards indications and controls a. Level Indications 1) Hot calibrated channels 2) Cold calibrated channel b. Recorder c. CCP discharge flow control valve d. PDP speed control e. Master level controller 4. Technical Specifications a. High pzr level reactor trip b. Remote shutdown instruments c. Accident monitoring D. EHC Description 1. Shell and Chest Warming a. Shell - warming steam is allowed to HP turbine shell b. Chest - warming steam is allowed to control valve chest only 2. Speed Control a. Describe time bias with starting rates (slow, medium, and fast) b. Use increase, decrease load pushbuttons to change speed when attempting to parallel 3. Load Control a. Auto transfer from speed to load control after shutting generator output breaker b. Use load limit set pot to limit maximum load c. Use increase/decrease load pushbuttons to set load in load set window

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.1 Title: System Review - CVCS, PZR Level , & EHC
	d. Use load rate pushbuttons to vary loading rates 1) Note that these rates apply only to load increases e. When decreasing power, use the load decrease pushbutton 1) No auto load decrease rate control. Power drops at 133%/min. As long as decrease load pushbutton is held down f. Stage pressure feedback 1) Used to bring actual load to desired load 2) Produces a linear response g. Throttle Pressure Limiter 1) Prevents excessive drop in steam pressure 2) If steam pressure drops too low, control valves will shut until pressure increases above setpoint

Lesson # 624P-2.2 Title: Operations - Reactor Startup	Time: 60 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following:

- 1.1.1 An understanding of how the core is made critical.
- 1.1.2 How to recognize criticality.
- 1.1.3 How to control the reactivity of the core.
- 1.1.4 Effects of subcritical multiplication.
- 1.1.5 Technical Specifications that may be entered during rod withdrawal.

2.0 References and Additional Materials

2.1 GOI 2-2 & GOI 2-3

2.2 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.2 Title: Operations - Reactor Startup

INIT 8 PLP RCS 1 MALF NIS 9	**3.0 Presentation:** A. After re-initializing remove 15 ppm boron from the RCS. B. Fail one IR channel Channel = 35 or 36 Value = 1.015 E-11 Ramp = 0 Delay = 0 C. Perform ECC 1. Discuss reactivity balance. 2. Explain same conditions as previous day. 3. No Xe, Sm, Fuel burnup changes. 4. Only have to account for boron change in RCS. 5. Convert boron change to PCM 's of reactivity/rod worth.
FREEZE **{TS 3.3.1}** **{Table 3.3.1-1 item 4 & 18}**	D. Perform Reactor Startup IAW GOI 2-2 1. When students discover failed IR, FREEZE 2. Discuss failed instrument a. T.S. action is power dependent b. Clear malfunction 3. Continue reactor startup E. Continue power escalation IAW GOI 2-3 F. Continue power escalation until all control systems are in automatic.

Lesson # 624P-2.3 Title: Operations - Power Maneuvering	Time: 3 Hours
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following:

- 1.1.1 An understanding of how power is escalated
- 1.1.2 How to calculate boric acid changes
- 1.1.3 How to maintain proper control rod position during power changes
- 1.1.4 How power defect affects control rod position
- 1.15 Technical Specifications that may be entered during power changes

2.0 References and Additional Materials

- 2.1 GOI 5
- 2.2 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.3 Calorimetric Worksheet (POT 22-1)
- 2.4 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.3 Title: Operations - Power Maneuvering
INIT 13 {TS 3.2.3} Periodic Operating Test 22-1 (To be developed)	**3.0 Presentation:** A. Perform a reactivity addition calculation 1. Use boron change worksheet 2. Use faber board to show calculation 3. Use a 30% to 75% power change as an example a. Explain power defect 1) P ↑ adds - reactivity 2) Must add + reactivity b. Explain why rods full out is desired 4. Explain rate of dilution a. Max dilution depends upon charging rate b. Max rate of power increase depends upon dilution rate and maintaining delta flux within its band B. Initial Conditions 1. Have shift supervisor perform a power ↑ to 1165 MWe over the next 2.5 hours 2. Tell students to follow all procedures and T.S. actions as necessary 3. Have shift supervisor read GOI 5 paragraph 4.12 thru 4.14 a. Explain that plants would have the fuel preconditioning limits but because of training time constraints will be disregarded C. Power ↑ to full load IAW GOI 5 1. Perform calorimetric at 50% a. Use calorimetric worksheets b. Explain that the calorimetric is performed to ensure that the NIs are calibrated to indicate thermal power c. Explain RCP and S/G blowdown correction factors that are applied to the calculation.

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.3 Title: Operations - Power Maneuvering

MALF PZR 11 FREEZE ONI 2-6 Section 12 Bistable trip is located in Rack 1 **{T.S. 3.3.1}** **{Table 3.3.1-1, Item 9}**	2. At approximately 60% power, fail PZR level channel 459 a. Set 1) Channel = 459 2) Level = Low 3) Delay = 180 seconds b. Activate 3. Go to freeze after students have selected out the failed channel a. Discuss the failed channel b. Analog channel check required at least once per 12 hours c. Discuss procedures to be followed 4. Continue power ↑ to 100%

Lesson # 624P-2.4	Title: System Review - Main Steam & Steam Dump Control	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Main Steam and Steam Dump Control Systems:

1.1.1 Controls that may be manipulated by the student during the course of a reactor startup and/or power operations.

1.1.2 Controllers that must be manipulated during power operations.

1.1.3 Indications available to the student from this location used to evaluate the status of the secondary plant.

2.0 References and Additional Materials

2.1 Main Steam System - High Pressure (page 13)

2.2 Main Steam System - Low Pressure (page 14)

2.3 Steam Dump Control System - Composite (page 28)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-2.4 Title: System Review - Main Steam & Steam Dump Control

INIT 16	**3.0 Presentation:** A. System Description 1. Main Steam a. Use the steam system diagrams to show the flow path of the steam from the S/G to the major steam loads
Panel C 02	B. Controls 1. Show the location and explain how to use the following: a. Main steam isolation valves b. Steam pressure controller PK-507 1) Explain how the setpoint for the pot is derived c. Steam dump mode selector switch d. Steam dump interlock switches e. Main steam isolation bypass valves f. S/G atmospheric relief valves 1) Describe both the manual and automatic operation of these controllers
Panel C 14/15	
Panel C 14 & C 5 Panel C 14 Panel C 14 Panel C 15 Panel C 15	C. Instrumentation 1. Show the location and explain the use of the following: a. Steam flow indicators b. Condenser back pressure c. Main steam header pressure d. Steam dump valve position e. Steam dump demanded position

Lesson # 624P-3.1	Title: System Review - Reactor Coolant System & Pressurizer Pressure Control System	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Reactor Coolant System and the Pressurizer Pressure Control System:

1.1.1 Controls that may be manipulated by the student during the course of a reactor startup and/or power operations.

1.1.2 Controllers that must be manipulated during power operations.

1.1.3 Indications available to the student from this location used to evaluate the status of the primary plant.

2.0 References and Additional Materials

2.1 Reactor Coolant System (page 1)

2.2 Pressurizer and Reactor Coolant Loop Connections (page 2)

2.3 Pressurizer Pressure Control System (page 24)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.1 Title: System Review - Reactor Coolant System & Pressurizer Pressure Control System

INIT 16	**3.0 Presentation:** A. System Description 1. Reactor Coolant System a. Use the RCS diagrams to show the flowpath of coolant around the loops.
	B. Controls 1. Show the location and explain how to use the following:
Panel C 12	a. Reactor Coolant Pump controls
	b. RCP oil lift pumps
Panel C 13 Panel C02	c. PZR Porv and block valve
	d. PZR heater controls
	e. PZR spray valve controls
	f. PZR master pressure controller
	C. Instrumentation 1. Show the location and explain how to use the following:
Panel C 12	a. Wide range RCS Pressure
	b. RCS flow
	c. RCP status
	d. RCP seal injection & leakoff
	e. Wide range and narrow range temperature
Panel C 09	f. Reactor vessel level
Panel C 13	g. PZR pressure
	h. Spray valve position

Lesson # 624P-3.2 Title: Operations - Power Maneuvering	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

1.1.1 An understanding of how power is changed

1.1.2 Technical Specifications that may be entered during power changes

1.1.3 Technical Specifications that may be entered as a result of equipment or instrument malfunctions.

1.1.4 Required actions that must be taken during minor equipment failures or instrument malfunctions

2.0 References and Additional Materials

2.1 GOI 5

2.2 Technical Specifications

2.3 Worksheets

2.3.1 At-Power Boron Concentration Change Calculations (OI 3-7)

2.3.2 Calorimetric Worksheet (POT 22-1)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.2 Title: Operations - Power Maneuvering

INIT 16	**3.0 Presentation:** A. Initial Conditions 1. Tell shift supervisor to decrease power to 600 MWe over the next 1.5 hours a. The reason for the power reduction is to remove the "A" main feed pump from service due to an oil leak. 2. Tell students to follow all procedures and T.S. actions as necessary. 3. Ensure the students calculate the boron change required for this power reduction. a. Remind the students to keep the rods fully withdrawn to prevent a xenon transient.
	B. Decrease power to approximately 50% IAW GOI 5.
MALF ROD 6A	1. Rod Control speed failure a. Set 1) Speed = 72 2) Delay = 0 b. Activate
MALF TUR 12A Respond IAW ONI 2-6 Section 6.0. Discuss failure of PT-505	2. Failure of 1st stage impulse pressure (PT-505) a. Set LOW b. Activate
{TS 3.2.3} **{TS 3.1.5}** **{TS 3.1.6}** **{TS 3.1.7}** **{COLR Figure 1 & 7}**	3. If delta flux limits or RIL are exceeded, then freeze the simulation and discuss these limits.
MALF MFW 3C	C. Approximately 45 minutes after the start of the scenario, insert the following: 1. Feed pump speed controller failure a. Set 1) Speed = 50% 2) Ramp = 300 3) Delay = 180 b. Activate

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.2 Title: Operations - Power Maneuvering
	2. Discuss speed control problems with feed pump after problem is found. a. Have to get power down to a point where one feed pump can handle the total feed flow.
MALF PZR 2A or 2B	D. At approximately 60% power, fail PZR PORV 1. Set a. Position = 1% to 5% open b. Ramp = 120 c. Delay = 120 2. Activate
FREEZE {TS 3.4.11} To remove power from the block valve after it is closed: P&ID RCS 3 - Select the affected valve - OPTION 4 {TS 3.4.1}	E. After students have diagnosed and responded by closing the associated block valve, freeze the simulator 1. Discuss the failed valve 2. Discuss the annunciation associated with this failure a. Tail piece temperatures b. All tail piece temperatures indicate the same after a short period of time due to the location of the sensors c. 0737 required alarm - PORV open 3. Discuss DNB parameters a. RCS Tavg ≤ 589 °F b. RCS pressure ≥ 2200 psia c. RCS total flow rate
	F. Continue power ↑ to 600 MWe 1. Discuss reason for not adding all of boron that was calculated a. Xe peaking in 4 to 6 hrs vs 48 to 52 hours for Xe to reach equilibrium conditions

Lesson # 624P-3.3 Title: Operations - Power Maneuvering	Time: 60 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

- 1.1.1 An understanding of how power is changed
- 1.1.2 Technical Specifications that may be entered during power changes
- 1.1.3 Technical Specifications that may be entered as a result of equipment or instrument malfunctions.
- 1.1.4 Required actions that must be taken during minor equipment failures or instrument malfunctions

2.0 References and Additional Materials

- 2.1 GOI 5
- 2.2 Technical Specifications
- 2.3 Worksheets
  - 2.3.1 At-Power Boron Concentration Change Calculations (OI 3-7)
  - 2.3.2 Calorimetric Worksheet (POT 22-1)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.3 Title: Operations - Power Maneuvering

INIT 16	**3.0 Presentation:** NOTE: DO NOT RE-INITIALIZE. Continue to operate from the previous plant conditions A. Initial Conditions 1. Clear the following malfunctions a. ROD 6A b. MFW 3C 2. Inform the shift supervisor that the main feed pump oil leak and the rod speed controller have been repaired. 3. Tell shift supervisor to increase power to 1165 MWe over the next 1.5 hours. a. The reason for the power increase is to allow shutting down one of the fossil unit due to boiler problems. 4. Tell students to follow all procedures and T.S. actions as necessary. 5. Ensure that the students calculate the boron change required for this power increase. B. Increase power to approximately 100% IAW GOI 5
MALF ROD 2A	1. Misaligned Control Rod a. Set 1) Select = D12 2) Failure = Trippable 3) Delay = 0 b. Activate 2. After the students recognize that a rod is stuck, freeze the simulator & then: a. Discuss the alarms that indicated this problem b. Discuss the following T.S. 1) Misaligned control rods 2) Rod position indication 3) Quadrant power tilt
{TS 3.1.5} **{TS 3.1.8}** **{TS 3.2.4}** ONI 2-4 POT 28-1	

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.3 Title: Operations - Power Maneuvering
MALF CVC 1 Select operating pump 1A or 1B	C. Approximately 45 minutes from initiation insert the following: 1. Charging pump failure a. Set 1) Failure = 1 2) Delay = 120 b. Activate 2. Discuss T.S. associated with a loss of a CCP a. Ask students what T.S. cover the charging pumps 1) Boration flow paths 2) Charging pumps 3) ECCS Subsystems F. Continue power increase to 1165 MWe

Lesson # 624P-3.4	Title: System Review - SW, CCW, and Containment	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Component Cooling Water, Essential Service Water, Containment Ventilation, and other miscellaneous ESF systems:

1.1.1 Controls that may be manipulated by the student during the course of a reactor startup and/or power operations.

1.1.2 Controllers that must be manipulated during power operations.

1.1.3 Indications available to the student from this location used to evaluate the status of the plant.

2.0 References and Additional Materials

2.1 Component Cooling Water System (page 33)

2.2 Service Water System (page 34)

2.3 Containment Air Flow Diagram (P&ID M-243)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.4 Title: System Review - SW, CCW, and Containment

INIT 16 C 18 PERM 7&8 on C 41 C 17 C 19 and C 09	**3.0 Presentation:** A. System Description 1. Use the Service Water diagram to show the flow paths and components served 2. Use the Component Cooling Water diagram to show the flowpaths and components served 3. Use the Containment Air Flow Diagram to discuss the flow paths of the various ventilation systems B. Controls 1. Show the location and explain how to use the following instruments: a. SW pump controls b. CCW pump controls c. Containment fan controls C. Instrumentation 1. Show the location & explain the use of the following instruments: a. CCW surge tank level and pressure b. CCW radiation monitor c. CTMT pressure, temperature, & humidity d. CTMT sump levels e. Wide range containment pressure

Lesson # 624P-3.5 Title: Operations - Power Maneuvering	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

- 1.1.1 An understanding of how power is changed.
- 1.1.2 Technical Specifications that may be entered during power changes.
- 1.1.3 Technical Specifications that may be entered as a result of equipment or instrument malfunctions.
- 1.1.4 The required actions that must be taken during minor equipment failures or instrument malfunctions.

2.0 References and Additional Materials

- 2.1 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.2 Calorimetric Worksheet (POT 22-1)
- 2.3 Technical Specifications
- 2.4 GOI 5
- 2.5 P&ID M1T(13)-11
- 2.6 P&ID M1T(13)-13

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.5 Title: Operations - Power Maneuvering

INIT 16	**3.0 Presentation:** A. Initial Conditions 1. Tell shift supervisor to decrease power to 500 MWe over the next 1.5 hours a. The reason for the power reduction is at the request of the load dispatcher 2. Tell students to follow all procedures and T.S. actions as necessary. 3. Ensure that the students calculate the boron change required for this power reduction. a. Remind students that they want to keep the rods fully withdrawn to ensure they don't start a xenon transient.
	B. Decrease power to approximately 45% IAW GOI 5
MALF PZR 10A	1. After approximately 30 minutes, insert the following malfunction, PZR pressure channel fails high. a. Set 1. HIGH 2. Delay = 180 b. Activate
	2. Monitor plant conditions - if the students do not respond correctly or are slow in their response, freeze the simulation prior to the OTΔT trip.
P&ID M1T(13)-11	a. Use the PZR pressure control diagram to show how the pressure channel failing high causes the pressure to drop
ONI 2-6 Sect. 9.0	b. Show how to remove the channel from the control circuitry
{TS 3.3.1} **{Table 3.3.1-1 item 8b}**	c. Discuss the applicable T.S. 1) As per the action statement, power operations may continue indefinitely
Bistables are in Rack #1 and Rack #2	3. Take the simulator out of freeze a. Have the students trip applicable bistables.

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.5 Title: Operations - Power Maneuvering
MALF SGN 17A P&ID M1T(13)-13 ONI 2-6 Section 14.0 **{TS 3.3.1}** **{Table 3.3.1-1 Item 15}** Rack #3	C. Approximately 60 minutes from initiation insert the following: 1. Steam pressure channel failure a. Set 1) Select =HIGH 2) Ramp = 120 3) Delay = 180 b. Activate 2. Monitor plant conditions - if the students do not respond correctly or are slow in their response, freeze the simulation. a. Use the SGWLC system diagram show how the steam pressure channel affects the steam flow signal to the control system b. Show how to remove the faulted channel from the control circuitry c. Discuss the applicable T.S. 1) As per the action statement, operations may continue indefinitely 3. Take the simulator out of freeze a. Have the students trip applicable bistables. D. Continue power decrease to 45% E. Summary 1. Review the annunciation that occurred as a result of the failed instruments 2. Review the bistables that were tripped as a result of the failed instruments, and point out these bistables on the RPS status panel.

Lesson # 624P-3.6 Title: Operations - Power Maneuvering *(OPTIONAL)*	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

1.1.1 An understanding of how power is changed.

1.1.2 Technical Specifications that may be entered during power changes.

1.1.3 Technical Specifications that may be entered as a result of equipment or instrument malfunctions.

1.1.4 The required actions that must be taken during minor equipment failures or instrument malfunctions.

2.0 References and Additional Materials

2.1 At-Power Boron Concentration Change Calculations (OI 3-7)

2.2 Calorimetric Worksheet (POT 22-1)

2.3 Technical Specifications

2.4 GOI 5

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-3.6 *(Optional)* Title: Operations - Power Maneuvering

INIT 14	**3.0 Presentation:** A. Initial Conditions 1. After initializing in IC 14, place the following controllers in manual a. Pressurizer pressure b. Pressurizer level c. Flow control valve 121 d. PK-131 e. Spray valves f. Pressurizer heaters to off g. Rod control h. Main feedwater control i. Master feed pump speed j. Steam dumps to off B. Instructions 1. Tell shift supervisor to increase power to 1165 MWe over the next 30 minutes. 2. Must complete the power increase with controls in manual. 3. Follow all applicable procedures and T.S. actions as necessary. C. Increase power to full load IAW GOI 5 1. If a reactor trip occurs, reset simulator. 2. If the students cannot maintain S/G water level without tripping the plant, place the feed pump speed controllers back to automatic. D. After approximately 30 minutes, rotate student positions and continue manual operations. E. Summary 1. Explain reason for this exercise is to show the students how reliable and fast acting the automatic control stations are as compared to the operator performing the same functions in manual

Lesson # 624P-4.1	Title: System Review - ECCS and ESF Status Panels	Time: 60 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Emergency Core Cooling Systems and the ESF Status Panels:

1.1.1 Controls that may be manipulated by the student during the course of a power operations and\or emergency operations.

1.1.2 Control switches that must be operated to block automatic signals to various components.

1.1.3 Indications available to the student from this location used to evaluate the status of the emergency core cooling system.

2.0 References and Additional Materials

2.1 Emergency Core Cooling System Composite (page 6)

2.2 Residual Heat Removal System (page 8)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.1 Title: System Review - ECCS and ESF Status Panels

INIT 16	**3.0 Presentation:** A. Controls 1. Show the location and explain the use of the following: a. RHR pumps b. SI pumps c. High head pumps d. Valves associated with lining up high head flow to cold legs e. Valves associated with lining up RHR f. Valves associated with lining up SI g. Accumulator discharge valves & vents B. Instrumentation 1. Location and use of the following: a. High head injection flow b. Safety injection flow c. RHR flow d. Discharge pressure of the pumps e. Accumulator pressure & level C. Show flow paths and controls on the control board D. ESF Status Panels 1. Describe the information available form the status panels 2. Demonstrate putting a pump in pull-to-lock 3. Show that not all valves are indicated if they are out of position

Lesson # 624P-4.2 Title: Operations - Power Maneuvering	Time: 60 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

- 1.1.1 An understanding of how power is changed
- 1.1.2 T.S. that may be entered during power changes
- 1.1.3 T.S. that may be entered as a result of equipment or instrument malfunctions.
- 1.1.4 Required actions that must be taken during minor equipment failures or instrument malfunctions

2.0 References and Additional Materials

- 2.1 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.2 Calorimetric Worksheet (POT 22-1)
- 2.3 GOI 5
- 2.4 Technical Specifications
- 2.5 P&ID

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.2 Title: Operations - Power Maneuvering
INIT 14 50% from 0% OR INIT 18 50% from 100%	**3.0 Presentation:** A. Initial conditions 1. Tell shift supervisor to increase power to 1150 MWe over the next 1.5 hours a. The reason for the power increase is due to a request from the load dispatcher 2. Tell students to follow all procedures and TS actions as necessary 3. Ensure that the students calculate the boron change required for this power change a. Remind the students that they want to maintain the rods as fully withdrawn as possible to ensure they don't start a xenon transient.
MALF RCS 16E Hot Leg OR RCS 16F Cold Leg	B. Increase power to approximately 100% IAW GOI 5 1. After approximately 20 minutes, insert the following RTD failure: a. Set 1) Value = 630 2) Ramp = 60 3) Delay = 180 b. Activate 2. Monitor plant conditions - if the students do not respond correctly or are slow in their response, freeze the simulation prior to the HI STM FLOW/LOW STM PRESS trip. a. Use the RCS temperature detector control diagram to show where Tavg and ΔT are used for both protection and control b. Show how to remove the faulted channel from the control circuit c. Discuss the applicable T.S. 1) As per the action statement operation may continue indefinitely
ONI 2-6 Section 3.0 **{TS 3.3.1}** **{Table 3.3.1-1 item 6}** **{Table 3.3.1-1 item 7}**	3. Take simulator out of freeze a. Trip the applicable bistables.
Rack #13	

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.2 Title: Operations - Power Maneuvering
MALF CVC2 **NOTE: This is non-recoverable. You must reset IC to clear.** ONI 6 Section 3.0 ONI 3.5 Section 4.0 NOTE: CC 220 is on M-215 Sheet 2, C3 and on P&ID CCW 6 Use this event to review P&ID drawings in the control room. **{TS 3.4.13}**	C. Approximately 45 minutes from initiation insert the following: 1. Letdown Leak a. Set 1) Value = 300 2) Ramp = 600 3) Delay = 180 b. Activate 2. Monitor plant conditions - after the students have identified that a leak exists, freeze the simulation and discuss the following: a. What actions should be taken to determine the location of the leak. b. How large is the leak and does it meet the definition of a leak or LOCA as per 10 CFR 50. c. Discuss applicable TS 1) RCS leakage d. Take out of freeze. C. When students commence shutdown, reset. E. Summary 1. Review the annunciation that occurred as a result of the failed instruments

Lesson # 624P-4.3 Title: Operations - RCS Leak	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

1.1.1 Technical Specifications that may be entered during power operations

1.1.2 Required actions for a reactor coolant system leak

1.1.3 Required actions to perform a plant shutdown

2.0 References and Additional Materials

2.1 At-Power Boron Concentration Change Calculations (OI 3-7)

2.2 Calorimetric Worksheet (POT 22-1)

2.3 GOI 3-1

2.4 GOI 3-2

2.5 GOI 4

2.6 GOI 5

2.7 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.3 Title: Operations - RCS Leak

INIT 14	**3.0 Presentation:** A. Initial Conditions 1. Tell shift supervisor to increase power to 800 MWe over the next 1.5 hours. a. The reason for the power increase is at the request of the load dispatcher. 2. Tell students to follow all procedures and T.S. actions as necessary. 3. Ensure that the students calculate the boron change required for this power escalation. a. Remind students that they want to keep the rods fully withdrawn to ensure they don't start a xenon transient B. Increase power to approximately 70% IAW GOI 5
MALF RCS 5A	1. After approximately 15 minutes, insert the following malfunction, reactor coolant system leak a. Set Rate = 50 Ramp = 600 Delay = 120 b. Activate
{TS 3.4.13} NOTE: DO NOT ALLOW THE STUDENTS TO TRIP THE REACTOR. MAKE THEM PERFORM A SHUTDOWN	2. This leak should be large enough to be positively identified as greater than TS limits and a plant shutdown should commence 3. Allow the students to follow the procedures and perform a reactor shutdown. Upon completion of the shutdown, discuss a normal plant cooldown. 4. During the shutdown, discuss the following: a. RCS leakage TS b. Cooldowns with and without offsite power available

Lesson # 624P-4.4 Title: System Review - Electrical Distribution	Time: 60 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information concerning the Electrical Distribution System:

1.1.1 Controls that may be manipulated by the student during the course of a power operations and/or emergency operations.

1.1.2 Indications available to the student from this location used to evaluate the status of the electrical distribution system.

2.0 References and Additional Materials

2.1 Station Power Composite (page 10)

2.2 230 KV System 1E (page 11)

2.3 12.47 KV Distribution (page 12)

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.4 Title: System Review - Electrical Distribution
INIT 16 OI 1-4 Section 5.0 OI 5-1 Section 3.2	**3.0 Presentation:** A. Controls 1. Show the location and explain the use of the following: a. Offsite breakers b. Main generator output breakers c. Vital power supplies d. Diesel generator controls B. Instrumentation 1. Location and use of the following: a. Generated load b. Diesel generator indications c. Load on various busses C. Explain control board mimicking for the electrical distribution system. D. Start and parallel a diesel generator to a vital bus. 1. Start and load the "A" (West) EDG. 2. Remove substation from service. 3. Re-connect substation to H-1. 4. When EDG is at IDLE. 5. Stop EDG

Lesson # 624P-4.5 Title: Operations - Power Maneuvering	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the following detailed information:

- 1.1.1 An understanding of how power is changed.
- 1.1.2 Technical Specifications that may be entered during power changes.
- 1.1.3 Technical Specifications that may be entered as a result of equipment or instrument malfunctions.
- 1.1.4 The required actions that must be taken during minor equipment failures or instrument malfunctions.
- 1.1.5 A chance to review the control boards at 100% power with no malfunctions active

2.0 References and Additional Materials

- 2.1 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.2 Calorimetric Worksheet (POT 22-1)
- 2.3 GOI 5
- 2.4 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-4.5 Title: Operations - Power Maneuvering

INIT 16	**3.0 Presentation:** A. Initial Conditions 1. Tell the shift supervisor to operate at full power with all conditions normal 2. Tell students to follow all procedures and T.S. actions as necessary 3. Tell students to look over panels to become familiar with the indications at 100% power with no malfunctions
P&ID SIS 2 **{T.S. 3.5.1}** OI 5-2 Section 1.3 LOA HIV 127 or just open the 152-101 A-1 feeder. NOTE: To clear remote 86 relays, LOA LOV 82 & 69 NOTE: Hagan controllers default to an AS - IS - MANUAL mode when power is lost. These may be returned to AUTO when/if power returns. Letdown also isolates. **{T.S. 3.8.9}** MALF HIV 4A + 5minutes MALF HIV 4B	B. Maintain full power 1. Approximately 45 minutes after starting, lower the pressure in B accumulator to 580 psig. 2. Monitor plant conditions - after the students respond to the annunciation freeze the simulation and discuss the applicable TS. 3. Go to run on simulation and have students pressurize the accumulator. 4. Approximately 15 minutes after the students have recovered accumulator pressure, trip power to A-1 bus. 5. When the "A" EDG powers the bus, go to freeze to discuss the equipment that was lost until the diesel generator sequences on the shutdown loads. 6. Discuss applicable TS. 7. Approximately 30 minutes after recovery of loss of bus, enter the following electrical malfunction: a. Activate loss of offsite power 8. Allow the students to complete the first four steps of EI-0 and ES-0.1. C. Summary 1. Review annunciation that resulted from the loss of bus and LOOP. 2. Review indicators of natural circulation.

Lesson # 624P-5.1 Title: Operations - Steam Generator Tube Leak	Time: 180 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information;

- 1.1.1 Technical Specifications that may be entered during power operations
- 1.1.2 Plant instrumentation required to diagnose a steam generator tube leak
- 1.1.3 Required actions for a steam generator tube leak

2.0 References and Additional Materials

- 2.1 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.2 Calorimetric Worksheet (POT 22-1)
- 2.3 GOI 3-1
- 2.4 GOI 3-2
- 2.5 GOI 3-12
- 2.6 GOI 4
- 2.7 GOI 5
- 2.8 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-5.1 Title: Operations - Steam Generator Tube Leak

INIT 16	**3.0 Presentation:** A. Initial Conditions 1. Tell shift supervisor to decrease power to 500 MWe over the next 2.0 hours. a. The reason for the power decrease is at the request of the load dispatcher. 2. Tell students to follow all procedures and T.S. actions as necessary. 3. Ensure that the students calculate the boron change required for this power reduction. a. Remind students that they want to keep the rods fully withdrawn to ensure they don't start a xenon transient.
MALF RCS 8D (One tube = 402 gpm or 578,880 gpd) **{T.S. 3.4.13}** NOTE: DO NOT ALLOW THE STUDENTS TO TRIP THE REACTOR. MAKE THEM PERFORM A SHUTDOWN	B. Decrease power to approximately 80% IAW GOI 5. 1. Insert the following malfunction, steam generator tube leak. a. Set Rate = 0.002 tubes (~ 0.8 gpm or 1157.8 gpd) Ramp = 600 Delay = 120 b. Activate 2. This leak should be large enough to be positively identified as greater than TS limits, and a plant shutdown should commence. 3. Allow the students to follow the procedures and perform a reactor shutdown. 4. When the shutdown has been completed transfer to the cooldown procedure & commence a controlled cooldown. 5. During the shutdown and cooldown discuss the following: a. TS dealing with S/G leakage. b. Actions that would be required if the tube leak develops into a tube rupture.

Lesson # 624P-5.2	Title: Operations - Power Maneuvering and Main Control Board Review	Time: 90 Minutes

Written By: R. D. Jones

1.0 Objectives

1.1 Provide the student with the following detailed information:

- 1.1.1 Technical Specifications that may be entered during power operations
- 1.1.2 Plant instrumentation required to diagnose a steam leak
- 1.1.3 Required actions for a small steam leak
- 1.1.4 Chance to review the control board at 100% power with no malfunctions

2.0 References and Additional Materials

- 2.1 At-Power Boron Concentration Change Calculations (OI 3-7)
- 2.2 Calorimetric Worksheet (POT 22-1)
- 2.3 GOI 5
- 2.4 Technical Specifications

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-5.2 Title: Operations - Power Maneuvering and Main Control Board Review

INIT 16	**3.0 Presentation:** A. Initial Conditions 1. Tell shift supervisor to maintain power at 100% 2. Allow about 30 minutes for review ofcontrol board at 100% power. 3. Have shift supervisor commence a power decrease to 700 Mwe. a. Reason for power reduction is preparation for night time grid loading (request is from load dispatcher).
MALF SGN 3D NOTE: This malfunction is for a steam break between containment and MSIVs. Open safety valve malfunction cannot be ramped.	4. Approximately 30 minutes after start insert the following steam leak: a. Set 1) Rate = 0.8 2) Ramp = 600 3) Delay = 240 b. Activate
NOTE: DO NOT ALLOW THE STUDENTS TO TRIP THE REACTOR.	5. As the power reduction commences, the opening of the safety valve will make up for some of the power reduction and reactor power should be abnormally higher than secondary load. 6. If students ask for outside tour, inform them of steam leaking out of pipes in top of building next to containment
{TS 3.7.1}	7. When steam leak is finally determined, discuss technical specifications associated with the steam generator safety valves 8. If the decision is reached to shut the plant down, remind the students of the Salem load reduction transient discussed in the advanced course 9. If desired, continue down power transient

Lesson # 624P-5.3 Title: Static Examination	Time: 90 Minutes
Written By: R. D. Jones	

1.0 Objectives

1.1 Provide the student with the ability to recognize abnormal conditions and/or Technical Specification items that are indicated on the main control panels.

2.0 References and Additional Materials

2.1 Static Evaluation Worksheets
2.2 Static Exam Answers
2.3 Course Evaluation Sheets

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-5.3 Title: Static Examination

Static exams are IC 41-50. Examination supporting information and forms can be downloaded and printed from: **OFFICE(K:)/Rttb/PWR/W/STATIC EXAMS**	**3.0 Presentation:** A. Select a static examination. B. Pass out the static examination evaluation worksheets with clipboards. C. Review rules of the exam from the front of the static evaluation worksheet D. Allow students (1) hour to review the panels and complete the static evaluation worksheet. E. At the end of the hour, review the exam and have the students grade their own. Note any problems that the student found that were not intended to be in the static F. Have the students complete the course evaluation sheets before they leave.
Final exam	

Lesson # 624P-9.1	Title: Mid Loop Demonstration, Bubble Formation, & RCS Heat up	Time: 60 Minutes

Written By: R. D. Jones/T.L. Bell

1.0 Objectives

1.1 Introduce the student Control Room during shutdown, depressurized and partially drained conditions.

- 1.1.1 Demonstration of mid-loop operations.
- 1.1.2 Discussions of system limitations.
- 1.1.3 Bubble formation in the pressurizer.
- 1.1.4 Reactor Coolant Pump heat up.

2.0 References and Additional Materials

- 2.1 GOI 12,
- 2.2 GOI 1-1
- 2.3 GOI 1-2
- 2.4 Technical Specifications
- 2.5 NUREG/CR-6144 Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1.
- 2.6 Computer and Quattro Pro spreadsheet.

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-9.1 Title: Mid Loop Demonstration, Bubble Formation, & RCS Heat up

IC 2 Cavity drained, head on, drained to loop centerline (62'), 2100 ppm Boron, 1 RHR pump in operation.

Set up for this demonstration will take ~ 30 - 45 minutes. Part 1 of this exercise is intended for demonstration ONLY.

IC 4 Pressurizer solid @ 400°F, 2100 ppm Boron, 1 RHR pump in operation.

IC 5 Pressurizer @25%, 4 RCPs running, RHR pumps are stopped, RHR is not isolated.

IC6 4 RCPs running, RHR isolated, Boron reduced.

Refer to CROC&TRM Figure 3.3A and 3.3B for Trojan specific information based on core load.

User ID "student"
Password "*leave blank*"

3.0 Presentation:

A. Discuss the Precautions and Limitations of GOI 12.
   1. Point out the indications available in the control room.
   2. Point out the limits on system operability and the number of systems that are tagged out of service.

BREAK

B. Briefly discuss Precautions and Limitations of GOI 1-1.
   1. Draw a bubble in the pressurizer IAW GOI 1-1.
   2. Stop at the completion of step 5.8

BREAK

C. Continue at step 5.8 of GOI 1-1.
   1. Skip step 5.13.
   2. Stop at completion of step 5.14.

D. Review GOI 1-2 steps 5.0 to 5.11. Continue operation at CAUTION 5.12.
   1. Continue heat up as time permits.
   2. Skip POTs and PICTs

E. Software Instructions - Windows NT
   1. A Quattro Pro spreadsheet that calculates the time for the RCS to reach 212°F from cold shutdown conditions has been created and loaded on the desktop computer.
   2. The spreadsheet also provides the student with information concerning the addition rate to match core boil-off, and the required flow rate to prevent boiling in the core should a loss of decay heat removal occur.

F. Loading Instructions
   1. Turn the computer and monitor on.
   2. Double click the "Time To Boil" icon to open the spreadsheet and display additional options.

Simulator IC, MALF, LOA, or TS Item	Lesson Number: 624-9.1 Title: Mid Loop Demonstration, Bubble Formation, & RCS Heat up

The following examples may be used for demonstration:	
72 hrs	480 hrs
120°F	100°F
87.97(BTU/#)	67.99
48.04(=80°F)	48.04
33.9 min	67.5 min
79 gpm	48 gpm
659 gpm	402 gpm

3. The student or instructor will have to input the following information:
   a. Time after shutdown in HOURS.
   b. RCS temperature.
   c. Enthalpy for the temperature in (b).
   d. On the boil off rate sheet, the injection fluid temperature and enthalpy must be entered.
4. The outputs on the spreadsheet are:
   a. Time for RCS to reach boiling temperature.
   b. Flow required to match boil off rate.
   c. Flow required to prevent boiling.

Simulator Exercise #1
Title: Inadvertent Reactor Trip
Written By R.D. Jones

INIT 16 1. LOA RCP9 TEST	A. Initiate load reduction to 50% without rod motion. 1. "A" RCP Breaker open. 2. SI will occur on Hi Stm Line ΔP. 3. Walk-thru E-0. **-END-** **EXERCISE #1**

Simulator Exercise #2
Title: Inadvertent Safety Injection
Written By R.D. Jones

INIT 16 Trip bistable 516D in Rack #16 before starting exercise. ONI 2-6 Section 14 If students recognize the potential for actuating SI, actuate: MALF ESF 3B Train A Failure Option 1	A. MALF SGN17E 1. Steam pressure failure. Transmitter - PT:525 Fail value - LOW 2. This should not cause reactor trip. 3. Trip bistables: 4. Follow E-0 and transfer to ES-1.1 to terminus.. **-END-** **EXERCISE #2**

Simulator Exercise #3
Title: Safety Injection with Loss of Off-site Power
Written By R.D. Jones

INIT 14 Turnover items: B EDG OOC 3hours-place Red Tag on breaker. B SI Pump OOC 5 hours-place Red Tag on breaker. ONI 16 Section 5.0 This will cause a LOW PRESSURE SI. Do not allow students to trip RCP to stop depressurization until told to do so in step 20. Discuss verbatim compliance vs. Operator initiative. Students should exit E-0 at step 24. Fail off-site power after transition is made to ES-1.1 LOA MIS 116 will start diesel air compressor	A. Initiate load increase to 100%. 1. MALF EDG1B OPTION 1 2. MALF SIS 1B OPTION 3 3. MALF NIS13; Power Range Channel Failure. Select any channel - 41, 42, 43, 44 Select final value - 120% Ramp time - 0 4. Pressurizer Spray Valve Failure. **FAIL** PZR4 (Valves) Select POSITION Select VALVE - 100% Ramp time - 300 sec. 5. Loss of Off-site Power. MALF HIV4A and HIV4B **-END-** **EXERCISE #3**

Simulator Exercise #4
Title: ATWS
Written By R.D. Jones

INIT 16 MALF ROD2A MALF ESF 2A and ESF 2B MALF MFW 3D and MFW 3C MALF MWF 1B	A. Initiate load decrease to 600 MwE. 1. Stuck rod (D-4) Protection system failure (Both) 2. Give operators about 10 minutes. Feedpump speed control failure (A) Failed speed - ~ 40% Ramp time - 300 Feed pump trip (B) Time delay - 300 B. Enter E-0. Transition to FR-S.1 at step 1. C. Enter FR-S.1. Complete procedure to terminus. Return to procedure and step in effect (E-0, step 2). D. Enter E-0, step 2. 1. ESF will probably be initiated during recovery of FR-S.1. 2. Continue E-0 to step 25. 3. Transition to ES-1.1, SI Termination E. Enter ES-1.1, take to terminus. **-END-** **EXERCISE #4**

Simulator Exercise #5
Title: RCP Seal Failure
Written By R.D. Jones

INIT 16	A.	Initiate load decrease to 50% over 2 hours.
MALF PZR 10A	1.	Pressurizer Pressure Channel Failure. Select channel - 455 Select failed value - HIGH. Delay time - 300 sec.
MALF MFW 12A	2.	Feedwater Flow Transmitter Failure. Select failed value - LOW Delay time - 1200 sec.
MALF RCP 4A	3.	RCP #1 Seal Failure Select leak rate - 115 gpm Ramp time - 600 Delay time - 300 (Optional)
MALF RCP 5A	4.	RCP #2 Seal Failure Select leak rate - 3 gpm Ramp time - 300 sec. Delay time - 600 sec. Conditional - **JMRCP4A**
MALF RCP 6A	5.	RCP #3 Seal Failure Select leak rate - 1.2 gpm Ramp time - 0 Delay time - 720 sec. Conditional - **JMRCP4A**
MALF RCS 5A	6.	RCS Leak Select leak rate - 200 gpm Ramp time - 0 Delay time - 0 Conditional - **JMRCP6A**
		-END- **EXERCISE #5**

Simulator Exercise #6
Title: LOCA
Written By R.D. Jones

INIT 16	A. Initiate load decrease to 600 MwE.
MALF RCS 5 (A,B,C, or D)	1. Reactor Coolant Leak. Leak rate - 1000 gpm Ramp time - 1800 sec. Delay time - 0 Conditional - **FNISPR.LE.90**
MALF CVC 1A	2. After SI initiation, Loss of Charging Pump (A). Conditional - **PT:457.LE.1700**
	3. Follow E-0 to E-1.
	-END- **EXERCISE #6**

Simulator Exercise #7
Title: Loss of Core Cooling / wo Loss of AFW
Written By R.D. Jones

INIT 16 Shift to the B CCP after reset.	A.	Initiate power increase to 100%.
LOA CVC 29 Disconnects breaker.	1.	Red Tag CCP(A) based on failure in first scenario. Place controller in PTL.
MALF EDG1B	2.	Diesel Generator B Failure.
MALF SIS1A		Safety Injection Pump Failure (A).
MALF RCS 1 (A,B,C, or D)	3.	Reactor Coolant Leak (w/o core cooling). Leak rate - 300gpm. Ramp time - 1800 sec. Delay time - 300 sec.
MALF HIV 6B	4.	ESF Bus B Trip No time delay Conditional - **JPPLSI**
		-END- **EXERCISE #7**

Simulator Exercise #8
Title: Steamline Break Inside Containment
Written By R.D. Jones

INIT 16 Shift to the B CCP after reset. MALF SGN 2 (A,B,C, or D)	A. Initiate power reduction to 800 MwE. 1. Steamline Break Inside Containment Select faulty SG Leak rate-6E6 Ramp time - 900. 2. This may result in a RED or ORANGE path for Containment Integrity. 3. Complete ES-1.1 **-END-** **EXERCISE #8**

Simulator Exercise #9
Title: Spray Valve Failure/ Station Blackout
Written By R.D. Jones

INIT 16 MALF PZR 6A (Auto failure) Students may take manual control MALF EDG 1B Execute Drill #38 MALF HIV 6A NOTE: Drill #39 is set up to perform manual actions required in ECA-0.0 as requested by the students.	A. Initiate load reduction to remove a main feedwater pump from service. 1. Pressurizer Spray Valve Failure Fail position - 100% Ramp time - 300 sec. 2. Diesel Generator B Fail to Start 3. Loss of Offsite Power 4. Failure of remaining ESF bus. Conditional - **OGENM.LT.40** Delay - 600 sec. 5. Stop exercise at ECA-0.0, step 23. **-END-** **EXERCISE #9**

Simulator Exercise #10
Title: Loss of Secondary Heat Sink
Written By R.D. Jones

INIT 14 Turnover item: Diesel AFW pump is out for repair. Declared non-operable 10 hours ago. Red Tag pump and place in PTL.	A. Initiate load increase to 100%.
MALF PZR 10A	1. Pressurizer Pressure Channel Failure Fail value - HIGH Delay time - 180 sec.
MALF AFW 1A &1B & 1C Execute steps 2 & 3 of Drill #38 to kill Off-site power.	2. Auxiliary Feedwater Pump Trip Option 3 - Fail to start
	3. When FR-H.1 step 9 loop is entered, clear MALF AFW 1A.
To start an air compressor after a momentary loss of power to B02 bus, line up fire main water to the B Joy air compressor (**LOA** MIS 72), and reset the lockout relay (**LOA** LOV 108) OR (**LOA** MIS 116) to start diesel air compressor.	
	-END- **EXERCISE #10**

Simulator Exercise #11
Title: RCS Leak /w Failure of RWST at RHR Common Suction
Written By R.D. Jones

INIT 16 This is an optional scenario. Instructor should be prepared to discuss this unlikely event, which is outside the design bases. The EOPs are not designed to cover this specific event.	A. Reduce power to 80%.
MALF RCS10	1. RCS Leak at Vessel Head Leak rate - 955 gpm. Ramp time - 300 sec.
MALF SIS 4 This break is in the common RHR pump suction line from the RWST. Not isolable. (P&ID M-206, Sheet 2, F-2)	2. RHR Suction Piping Failure Leak rate - 10,000 gpm Ramp - 300 sec. Conditional - **JPPLSI**
	-END- **EXERCISE #11**

Simulator Exercise #12
Title: Steam Line Break Outside Containment \ w SGTR
Written By R.D. Jones

INIT 16	A.	Reduce power to 80%.
MALF SGN 3D	1.	Steamline break outside containment and upstream of MSIV Leak rate - 6 Ramp time - 600 sec. Delay time - 600 sec.
MALF RCS8D	2.	Steam generator tube leak. 2 tubes (~804 gpm) Ramp time - 60 sec. Conditional - **JPPLSI**
		-END- **EXERCISE #12**

Simulator Exercise #13
Title: Steam Generator Tube Leak
Written By R.D. Jones

INIT 13 MALF RCS 8B	A. Initiate power increase to 50% 1. Steam Generator tube leak Leak rate - 0.25 tubes (~100 gpm) Ramp time - 3600 sec. Delay time - 300 sec. **-END-** **EXERCISE #13**

Simulator Exercise #14
Title: Steam Generator Tube Leak
Written By R.D. Jones

INIT 14 MALF ROD 3K MALF RCS 8D	A. Initiate power increase to 50% 1. Rod control group C1 fails to move. 2. Steam Generator tube leak Leak rate - 0.75 tubes (~300 gpm) Ramp time - 3600 sec. Delay time - 600 sec. **-END-** **EXERCISE #14**